General Description of Resource Operation

Introduction: In its fourth year of existence, the ACME Project offered the time-sharing and real-time data-acquisition services developed during the first three years and sought to improve its level of service and reliability. The most significant change during the past year has been the full implementation of "user fees." The fee for service concept was started in March, 1969, but only recently have nearly all users become "eligible" for accepting charges due to grant restrictions imposed by the National Institutes of Health.

A brief summary of the years events follows: July, 1969, was a record month for terminal hours yielding 4,400 hours of terminal connect time. In August, N.I.H. awarded a new grant covering ACME. During the fall of 1969, utilization dropped markedly as the full impact of user charges became evident. Many new contract and grant awards from Federal agencies provided fewer dollars than had been hoped for and anticipated. January, 1970, marked the installation of an additional 64,000 bytes of high-speed core on the 360/50. The effect of the high-speed core addition was to cut compilation time in half. This also reduced the effective page minute or core residency charges by providing users with more efficient computing. In recent months the system appears to be achieving a new equilibrium described in more detail below in the section on utilization. In June, additional core for the 1800 will be ordered as will some additional CRT's. Throughout the year, the staff emphasized tasks which would improve hardware and software reliability.

Organizationally, two changes occurred in the past year. A new subcommittee to the ACME Policy Committee was established to serve as a short and long-range plan review group. This subcommittee consists of Dr. Elliot Levinthal, Dr. Edward

Feigenbaum, and Mr. Gio Wiederhold. In May, 1970, Mr. Ron Jamtgaard was appointed Director of the ACME Facility.

In late May, the staff of ACME began an evaluation of various methods of providing desired expansions to standard services. A key question involved is the basic approach of adding one medium-sized satellite processor to handle a variety of functions versus multiple mini-computing systems each handling one or two functions. The study was extended into June, thereby missing the deadline for this report. Some of the incremental services being considered are: multiple processor access to 2314 disk files; expansion of available 2741 ports; back-up or redundant capacity for recording data from real-time data-acquisition users; various fail-safe devices for terminal users; and allowance of considerable expansion room in the field of graphics in terms of central hardware.

This Annual Report covers the period August 1, 1969 through May 31, 1970, plus estimated operating results for the period through July 31, 1970. ACME was created in July, 1966, under a three-year grant from National Institutes of Health, Special Research Resources Branch. The initial goal was to provide a time-shared computer facility and real-time, data-acquisition system for research groups within the Stanford Medical Center. A second three year grant was approved by NIH in August, 1969. The primary goal of the second three-year grant has been improvement of reliability of both hardware and software. The facility is administered by the Stanford Computation Center under the direction of Paul Armer.

The ACME System achieved the initial goal with considerable success. There are over 200 projects presently on the system operating from some 50 terminals in the Medical Center. In addition, there are twenty-one (21) laboratories connected to ACME for real-time data-acquisition and process control.

ACME's hardware consists of an IBM 360/50 with a 2-million byte extended core storage, plus an IBM 1800 processing unit used for data-acquisition and control of graphics devices. The language used is a subset of PL/1 which was chosen for its power and ease of learning.

For more details on tasks accomplished during the past year and new "core research" tasks started, refer to Description of Core Research Activities on page 9.

SOME GOALS AND ACCOMPLISHMENTS OF PAST YEAR:

SOFTWARE RELIABILITY: In the grant proposal one year ago, it was noted that software failures stem mainly from interface problems between IBM's Operating System and the ACME system, error recovery procedures within OS, unanticipated user demands, etc. Failure rates were shown to be dependent on the rate of change of the software system. At that time, approximately one-third of the total system failures were caused by software. One plan for the new grant period was to reduce the number of modifications to the system by taking advantage of the existing structure to meet new requirements. In practice, this intent has been only partially satisfied. New software has been added to the system using the basic structure (a command "Show Undefined", graphics control software for "add on" graphics units to be used in conjunction with 2741 typewriter terminals; etc....) However, some changes have called for modifications to the basic structure: software for the link between Campus Facility 360/67 and the ACME system, and a new communications software package for the 1800. The goal was to improve the system to a point where software would be responsible for system failure no more often than once every two to three weeks. Despite much effort on this activity over the past nine months, software accounted for 10 failures between mid-April and mid-May. The effort will continue.

HARDWARE RELIABILITY: The proposal cited three specific hardware boxes which had caused an inordinate number of system failures -- 2702 transmission control unit, 7720 adapter for the 1800, and the 270X-Y high speed data transmission units. The problems involving the 2702 device appear to have been solved. This unit has failed only three times in the past year and has operated without failure for the past nine months. The 7720 adapter for the 1800 continued to provide some problems until a software solution was implemented. In addition, a number of recent crashes of the 1800 system have been traced to the input/output hardware. The cause of the problem remains unidentified. A number of IBM service personnel have been assigned to this task with no success to date.

The 270X high speed data transmission unit has proven totally unsatisfactory. The unit was provided on an experimental basis by IBM, and was purchased jointly by Dr. Djerassi's Chemistry Laboratory, Dr. Levinthal's Instrumentation Research Laboratory, and ACME. In recent negotiations, IBM offered to buy back the 270X and four 270Y's. In the near term ACME hopes to replace the 270X with a satellite computer system. The exact configuration of the satellite system is dependent upon further study by ACME and the Chemistry Laboratory. The issue should be resolved prior to the end of July, 1970.

During the past year ACME has monitored preventive maintenance work performed by the manufacturer's Customer Engineer more closely. This step has proven effective in isolating hardware from software problems and has helped to keep hardware at a proper operational level.

A failure control program has been initiated. The system has been modified so that many flaws which formerly caused the entire system to crash are now trapped and allowed to impact only one user. ACME has taken over operation of the machine hardware error interrupt operation.

REAL-TIME DATA ACQUISITION: The proposal called for two significant changes on the 1800. First, more core storage was to be added in order to increase the 1800 capacity from 16 simultaneous lines to about 48 effective lines. Secondly, software multiplexing was to provide an increase from 12 actual simultaneous lines to approximately 24 effective lines. So far 12 actual lines have been increased to 16 lines. However, the additional core is to be ordered in June, 1970 and this acquisition will permit the changes to be made. At the present time, all core on the 1800 is full; a recent system change could not be implemented immediately due to a shortage of only 8 words of memory. It is packed tight.

SERVICE: ACME provides services for a wide variety of applications. The system design is such that almost any user requirement can be met within the existing framework. The uses of ACME fall into a number of discrete categories, although a given user may have several projects which fall into different categories.

Real-time data collection and analysis is a major category which may be subdivided by data source and type of analysis. Sources which may be identified are: direct input from instruments with a wide range of data acquisition rates - such as mass spectrometers, blood analyzers gas chromatographs and related instruments; direct input from subjects (human and animal) such as EEG, EKG, catheterization pressures, respirator functions and other physiological parameters; and immediate terminal input of experimental data. The types of analyses on these data are quite varied. They include auto-correlations, cross-correlations, Fourier analysis, peak location and classification programs, area determinations, and many others.

Mathematical modeling and computation is another category in which there is considerable activity. Projects include neutron diffraction studies, molecular modeling, respiratory function models, heart electrical activity models, and other similar studies.

In the category of data storage, retrieval and manipulation are projects in human and animal genetics, psychological test data, a stroke registry, a drug interaction study, and clinical laboratory data collection and dissemination. It is expected that projects involving patient care will increase dramatically in the near future.

DESCRIPTION OF CORE RESEARCH ACTIVITIES

The following paragraphs describe projects which are potentially useful to several biomedical investigators. The identification of the need for research in a particular computer application may originate with a single user; but the ACME staff is aware of the possibilities of wider utilization. The staff is, of course, at all times also concerned with improving the efficiency of the system for the benefit of all users.

1. The STRUCTURE feature of the PL/1 language has been implemented on ACME for data files. This feature allows the writing of mixed variable types into a single file record such as a character string for a label and an array of numeric data. Such record structures are frequently required for patient record files and until now had to be simulated using characters only for record formats.

2. CSMP: The implementation of the Continuous Systems Modeling Program is well underway. The ability to develop significant models of physiological processes is of major importance to predictive analysis of drug and other treatment methods. We expect that a machine of the speed of ACME will not allow very extensive simulation of physiological models, and that developed models will be shipped over a link to the Campus Facility 360/67 for processing; but having interactive capability during the model development process is essential for the design and debugging of non-trivial processes without assistance of computer specialists.

3. Link: The hardware link between the ACME and Campus Facility systems is complete and data has been transmitted experimentally over the link. At present, user-oriented software is being written and a system to translate ACME to OS files and the reverse is being coded.

4. Variable Length Files: A file system modification to allow records of any size to be written is being developed. At present, individual records are restricted to a maximum of 1984 characters per record. A by-product of this modification will be the ability to handle a larger variety of storage devices and as such a lessening of single vendor dependence

5. Small Machine Support: Improved support for small machine users is becoming a major research effort. A small machine assembler has been written on ACME which will generate codes for the PDP-8, PDP-12, LINK, LINK-8, or 1800. It will be expanded to include other small machines as the need arises. The assembler is conversational and offers powerful editing features. It is in check-out phase at present and will soon provide software development for several small machines currently in the laboratories of medical investigators.

6. 1800 Disk Spooling: The 1800 data collection system has been expanded to include a facility for spooling data to the 1800 disk and retrieving it after collection. This feature operates in a way which makes it independent of the 360/50 status and is therefore suitable for data collection on long experiments (such as sleep experiments and long scintillation counter runs) when the main system might be down or is being used for the nightly file maintenance procedures. This continuous data collection task was identified in the proposal as a requirement.

7. 1800/360 Communications: The 1800/360 communication software has been rewritten to provide greater speed and more sophisticated error recovery techniques. As far as we know, we have been able to overcome (by programming) IBM's design deficiencies in its 1800/360 direct link and we are among the few, if not the only installation, using this facility intensively. Double precision

has been implemented for all arithmetic functions. These routines have been thoroughly checked and rewritten where required for speed and accuracy.

8. Graphics: The proposal called for adding central hardware to accomodate up to 16 CRT's. It was also assumed that a second interactive graphics unit would be needed (see addendum to original proposal). In view of the high cost associated with the second interactive graphics unit, the limited budget, and the general interest demonstrated in CRT's, the plan was changed. Instead of providing central hardware for 16 units, ACME has placed orders for "add on" type displays which will be available for users to mount in their laboratories and offices. The units (including CRT and hardware interface) will cost slightly less than $5,000 each. From three to six units should be available by late July or early August, 1970.

9. Heuristic Problem Solving: In May, ACME started a new research effort by adding one senior staff member with considerable experience in LISP. The LISP language typically requires extensive amounts of core which ACME can provide. By mid-summer, a batch version of LISP will be mounted during the overnight service blocks on ACME. By late summer, an interpretive version of LISP will be made available to ACME terminal users. The significance of this addition can best be demonstrated in terms of a research project called DENDRAL involving Drs. Joshua Lederberg and Edward Feigenbaum. The name "Dendral" was given an algorithm developed by Lederberg which is capable of generating all of the topologically possible isomers of a chemical formula. Heuristic DENDRAL will perform the following two classes of tasks: (1) Given the mass spectrum of an organic molecular sample and the chemical formula of the molecule, the program will produce a short list of the molecular "graphs" as hypotheses to explain the given data in the light of the program's models of mass spectrometric processes and stability of organic molecules. The list is rank-ordered from the most satisfactory explanation to the least satisfactory; and (2) If no mass spectrum

is given, but only a formula, the program will produce a list of all the chemically plausible isomers of the molecule in the light of its model of chemical stability of organic molecules. According to Feigenbaum, "The flow diagram of the system is a closed loop consisting of phases of data inspection, hypothesis generation, prediction, and test, corresponding closely to a simple 'scientific method' loop." It is assumed that the results of DENDRAL operated on the ACME system will lead others in the Medical School to investigate heuristic problem solving techniques using computing.

10. File System Improvements: File system changes have been made to increase ease of data manipulation. Increased utilization of the facility for data storage and retrieval is anticipated, particularly by those involved in direct patient care. The reliability record of the ACME file system gives cause for considerable pride. Only two user data blocks have been lost in the entire history of ACME.

TRAINING:

ACME continues to offer informal courses in the use of the system to both beginning and advanced users. The beginning course is given an average of twice monthly and the advanced class once a month. Class size is usually about ten students. Each course consists of three one and one-half hour sessions. All ACME programming personnel spend a portion of their time consulting with users. In addition, three full-time and one part-time staff members are completely involved with consulting for users.

A formal course in biomedical computing is now being offered to medical students by the Genetics Department, using ACME as their primary computing system.

PLANS AND OBJECTIVES:

During FY 1971 and FY 1972 efforts will continue in the area of realiability. Soft-

ware reliability will improve as the basic system becomes increasingly stable. Major work on hardware error recovery is indicated by the failure statistics. As most hardware errors are transient in nature, and quite often only impact a single user, it is obvious that considerable improvement can be made.

The 270X and four 270Y's will be replaced as soon as possible.

The 1800 core will be expanded by late summer. Increased usage is causing some users to delay their experimental procedures while waiting for available ports to the 1800. The storage scope displays are being supported on the 1800 in line with ACME policy to support all non-standard devices on the 1800 or satellite system in order to insulate operation of the 360/50 from real time users as much as possible. The 1800 is almost immune to external device failure and therefore system reliability is enhanced. Small machine support will be a major effort. In addition to the assembler, a method allowing the use of the PL/ACME language and its compiler to compile code for small machines is being investigated. New methods of allowing the small machines access to ACME are under consideration. It is felt that the support of small machines is an area that requires considerable research and cooperation to provide a true symbiotic relationship.

The support of a version of the General Purpose Simulation System language (GPSS) is under consideration. The language (GPSS) is designed for operations research-type problems and would be very applicable to patient scheduling, clinical laboratory systems, and similar activity modeling.

The plans for LISP have been described above. Hopefully, another team within the Medical Center will be found with strong interest in problems which LISP can readily support.

ACME will continue to expand its direct user support activities of teaching

and consulting. More sections of the Medical Center Will be introduced to ACME and its capabilities. The direct patient care areas appear to be the most likely candidates for near-term seminars and lectures on computing in general, and on ACME. The data acquisition and control users of ACME are well established and can be expected to grow, requiring from ACME a continued level of engineering and consulting support.

UTILIZATION DATA:

On March 26, 1970 a rate change was announced to users. The change was made retroactive to February 16. A summary of utilization data for the period August, 1969 through May, 1970, is presented below.

Total Utilization from August 1969 - May 1970

Month	Page Minutes	Blocks
August 1969	2,605,374	135,632
September	2,633,017	124,443
October	1,773,297	116,272
November	1,576,599	114,130
December	2,002,034	112,806
January 1970	1,637,933	112,122
February	1,875,170	107,812
March	2,604,178	115,308
April	2,356,168	108,059
May	2,546,881	106,660

Note that the above figures include utilization by ACME staff which normally accounts for 10% to 14% of total usage of page minutes. A "page minute" is defined as the holding of one page or 4,000 bytes in core for one minute. The general downward trend in use of page minutes from August through January is

attributed to the inception of user charges, reduced availability of grant funding from Federal sources, and addition of high speed core on the Model 360/50. Charging for ACME service was initiated in March, 1969; however, most users' grants were not eligible to receive charges until later in the year. Various parts of the ACME/PL system were moved from 8 microseconds bulk core to the incremental high speed core added in January, 1970. The effect of this shift is to speed up compiling, thereby resulting in fewer page minutes being charged to the user.

Note that the August, 1969 level of 2.6 million page minutes was nearly attained in May, 1970 despite the effect of charging for services. Also note that 2.54 million page minutes in May reflects more computing than 2.6 pageminutes last August due to the addition of high speed core to the 360/50.

The number of terminal hours (2741 connected hours) dropped sharply from a peak over 4400 hours in July, 1969, to about 2400 hours in December. The effect was desired and predicted. By adding charges for system use, a system of allocating scarce resources was implemented. Presumably, users make more efficient use of terminal connect time. Since that time, about 50% of the drop has been recouped. The past four months have been roughly equal in terms of terminal hours.

ACME file utilization has remained essentially constant over the past six months at about 70% of capacity. The present capacity is approximately 400 million bytes or two IBM 2314 Direct Access Storage Devices. In August, 1969, disk usage hit a high of 86% of capacity. The reduction appears to be due to the change to "fee for service" and to better knowledge on the part of users about efficient file handling.

RATES FOR USER SERVICE CHARGES:

In addition to renting their terminals, ACME users are charged for two elements of service -- page minutes and disk storage. Page minutes are charged at

varying rates based upon a User's classification. For example, a lower rate is charged to real-time data collection users involved in medical research than is charged to non-medical or practicing clinical users. Some users are totally supported by the Facility Grant; such users include medical students and research users whose grants from NIH are ineligible to pay for computing.

After nearly one year of charging user fees, a rate reduction seemed to be indicated. The revenue goals of the facility could be met despite a rate reduction. At the same time the funding of many medical research projects was reduced placing computing requirements in competition with other needs within limited budgets. The rate change included the addition of a constant "add on" of two and one-half pages to each program regardless of the program size. The intent of this added charge was to increase the cost of tying up a terminal port for a protracted time while using very few page minutes for computing. Limited port capacity into the 360/50 (31 ports) coupled with certain user behavior led to the adoption of this new rate.

In January, 1970 the 360/50 was upgraded by the addition of 64,000 bytes (characters) of high-speed core memory. This resulted in an increase in system speed of almost 50 percent. This was the only major modification during the year to date. During the balance of the year, additional core for the 1800 will be ordered as well as additional "add on" graphics CRT's.

The table on the next page compares the two rate schedules in effect during the period covered by this report.

User Categories	3/21/69 - 4/15/70	4/16/70
	Rate Per Page Minute	
Biomedical Research Service-RealTime	1¢	1/2¢
Biomedical Research Service-Routine Terminals	2¢	1¢
Biomedical Research Service-Outside Stanford	3¢	2¢
Stanford Medical School and Hospital Administration	1 1/2 ¢	1 1/4¢
Stanford, non-medical school	3¢	2 1/2¢
Pilot projects and projects anticipating funding	No Charge*	No Charge*
Student education, Medical School	No Charge	No Charge
ACME staff	No Charge	No Charge
	Storage Block per Month	
All Chargeable users		10¢
Medical School students; pilot project or funding anticipated; ACME staff		No Charge
	Connect Time charge	
All Chargeable users		2 1/2 page minutes X r(rate) X t(time)
Medical School students, pilot project or funding anticipated; ACME staff		No Charge

* subject to approval of Subcommittee (of Policy Committee) on user charges.

SUMMARY OF COMPUTER RESOURCE USAGE
CORE RESEARCH PROJECTS
Period Covered 4/21/69 - 4/16/70

INVESTIGATOR	DEPARTMENT INSTITUTION	PROJECT TITLE	DIRECT GRANT OR CONTRACT SUPPORT Identification Number	Agency	Current Annual Amt.	User Category	COMPUTER EQUIPMENT General Description	Pageminutes(K)	Block Storage(K)
						7	ACME staff	at .1 cent per pageminute (full credit)	at .10 cents per block (full credit)
Allen, L.	Computation Center	System tests.	*RR00311	NIH		7		2	40
Bassett, R.	ACME	User consultation.	*RR00311	NIH		7		369,973	5,290
Beebe, R.	Computation Center	System demonstrations.	*RR00311	NIH		7		1	104
Berns, R.	Computation Center	System demonstrations.	*RR00311	NIH		7		1	172
Breitbard, G.	ACME	System development and testing.	*RR00311	NIH		7		33,389	721
C.E., IBM	ACME	Terminal testing.	*RR00311	NIH		7		20,627	228
Class, C.	ACME	Daily operations equipment inventory; system testing and demonstration.	*RR00311	NIH		7		1,084,070	2,037
Cower, R.	ACME	Daily operations.	*RR00311	NIH		7		4,261	17
Crouse, L.	ACME	Development of real-time medical procedures.	*RR00311	NIH		7		92,423	28,777
Cummins, D.	ACME	Communication systems development.	*RR00311	NIH		7		23,018	547
De la Roca, D.	ACME	Assembler development.	*RR00311	NIH		7		61,234	1,906
Emerson, D.	ACME	File system development.	*RR00311	NIH		7		285	45
Feigenbaum, E.	Computation Center	System demonstrations.	*RR00311	NIH		7		4,626	119
Feigenbaum, E.	Computation Center	System demonstrations.	*RR00311	NIH		7		0	24
Frey, R.	ACME	File system testing; consulting programs.	*RR00311	NIH		7		51,240	2,337
Girardi, S.	ACME	File testing.	*RR00311	NIH		7		86,581	4,111
Godwin, J.	ACME	Student instruction: how to use ACME.	*RR00311	NIH		7		1,449	81
Granieri, C.	ACME	System development and testing.	*RR00311	NIH		7		15,693	1,280
Granieri, C.	ACME	System development and testing.	*RR00311	NIH		7		40,625	1,810
Gray, R.	ACME	Daily operations.	*RR00311	NIH		7		2	20
Hattendorf, V.	ACME	Text editing.	*RR00311	NIH		7		78	132
Hundley, L.	ACME	Real-time data acquisition.	*RR00311	NIH		7		70,430	3,554
Kelley, E.	ACME	Daily operations.	*RR00311	NIH		7		425,375	1,599
Known, U.N. (Miscellaneous Users)	ACME	Minor student desk calculator services; no file storage.	*RR00311	NIH		7		1,587,015	46
Lederberg, J.	Genetics	System tests.	*RR00311	NIH		7		1	280
Lederberg, J.	Genetics	Test editing.	*RR00311	NIH		7		40,635	6,927
Lederberg, J.	Genetics	Program development.	*RR00311	NIH		7		83,229	12,335
Liere, R.	ACME	Library programs.	*RR00311	NIH		7		232,873	6,307
Liere, R.	ACME	Statistical programs.	*RR00311	NIH		7		2,264	1,018

* Grant supporting more than one user.

SUMMARY OF COMPUTER RESOURCE USAGE
INDIVIDUAL USER PROJECTS
Period Covered 4/21/69 - 4/16/70

INVESTIGATOR	DEPARTMENT INSTITUTION	PROJECT TITLE	DIRECT GRANT OR CONTRACT SUPPORT Identification Number	Agency	Current Annual Amt.	User Category	COMPUTER EQUIPMENT General Description	Pageminutes(K)	Block Storage(K)
						7	ACME staff	at .1 cent per pageminute (full credit)	at .10 cents per block (full credit)
Matous, J.	ACME	Daily operations.	*RR00311	NIH		7		1,221	346
Miller, J.	ACME	Assembler development.	*RR00311	NIH		7		644	381
Miller, J.	ACME	File development.	*RR00311	NIH		7		477	1,690
Miller, S.	ACME	System development.	*RR00311	NIH		7		22,865	498
Montgomery, R.	Computation Center	Text editing.	*RR00311	NIH		7		0	6
Morris, M.	Genetics	Departmental service routines.	*RR00311	NIH		7		49,064	8,029
Osborne, D.	ACME	System tests.	*RR00311	NIH		7		18,485	388
Osterby, O.	ACME	System development.	*RR00311	NIH		7		6,753	69
Plasch, G.	ACME	Text editing.	*RR00311	NIH		7		21,505	2,617
Public, J.Q.	ACME	Development and storage of PUBLIC files.	*RR00311	NIH		7		50,563	6,429
Rieman, J.	ACME	Daily operations.	*RR00311	NIH		7		4,708	218
Salisbury, J.	ACME	System development.	*RR00311	NIH		7		23,969	1,366
Sanders, G.	ACME	User consultation.	*RR00311	NIH		7		11,603	1,251
Sanders, W.	ACME	Hardware and software development.	*RR00311	NIH		7		13,219	2,698
Sandoval, C.	ACME	Daily operations.	*RR00311	NIH		7		12,736	21
Schlumberger, M.	ACME	System development.	*RR00311	NIH		7		0	1
Smith, P.	ACME	System tests by IBM system engineer.	*RR00311	NIH		7		11,527	738
Sutter, J.	ACME	Daily operations.	*RR00311	NIH		7		140,088	419
User, A.	ACME	Programming aid for users.	*RR00311	NIH		7		4,403	41
Van Tassel, J.	ACME	Daily operations.	*RR00311	NIH		7		157,309	357
Whitner, J.	ACME	Statistical program development.	*RR00311	NIH		7		66,819	184
Wiederhold, G.	ACME	Developing continuing system modeling program.	*RR00311	NIH		7		2,041	3,987
Wiederhold, G.	ACME	Demonstrations for visitors to ACME.	*RR00311	NIH		7		22,205	1,786
Wiederhold, G.	ACME	System testing to make sure it meets old and new specifications.	*RR00311	NIH		7		59,188	3,934
Wiederhold, G.	ACME	Usage statistics, accounting, and yearly reports.	*RR00311	NIH		7		56,162	9,374
Wiederhold, V.	ACME	Editing the PL/ACME manual.	*RR00311	NIH		7		11,981	962
Wilson, D.	ACME	Development of real-time medical procedures.	*RR00311	NIH		7		0	5
							TOTAL	5,100,935	129,659

* Grant supporting more than one user.

SUMMARY OF COMPUTER RESOURCE USAGE
INDIVIDUAL USER PROJECTS
Period Covered 4/21/69 - 4/16/70

INVESTIGATOR	DEPARTMENT INSTITUTION	PROJECT TITLE	DIRECT GRANT OR CONTRACT SUPPORT Identification Number	Agency	Current Annual Amt.	User Category	COMPUTER EQUIPMENT General Description	Pageminutes(K)	Block Storage(K)
						1	Biomedical research service - real time	at .01/2 cent per pageminute	at .10 cents per block
Anderson, D.	Genetics	Instrumentation and control of mass spectrometer.	*NSG8160	NASA	$459,717.50	1		39,653	843
Bacon, V.	Genetics	Operating quadrupole mass spectrometer.	*NSG8160	NASA	459,717.50	1		973,571	28,457
Bridges, J.	Genetics	Control of quadrupole mass spectrometer.	*NSG8160	NASA	459,717.50	1		12,680	244
DeGrazia, J.	Nuclear Medicine	Evaluation of rate of metabolism of specific biochemical pathways in human disease.	RG69	National Academy of Science	1,573.73	1		14,568	561
Hanawalt, P.	Biological Sciences	Use of radioisotope tracers in studies of molecular biology of cell growth and repair of damage to genetic material.	GM09901	NIH	82,976.19	1		77,278	820
Harrison, D.	Cardiology	On-line cardiac catheterization data analysis; recognizing abnormal EKG complexes.	HE09058	NIH	37,236.10	1		150,531	6,807
Jones, R.	Biochemistry	On-line kinetic measurement of fluorescence as a function of time-data acquisition and data reduction.	*NGR05020	NASA	54,783.20	1		10,274	12,773
Kennedy, D.	Biological Sciences	Analysis of neurophysiological data.	NB02944	NIH	35,648.25	1		0	6
Lederberg, J.	Genetics	Automation, operation, and service on the Finnigan 1015 mass spectrometer.	*NSG8160	NASA	459,717.50	1		0	6
Lederberg, J.	Genetics	Program instruction; work area for programming and instrumentation use practice.	*NSG8160	NASA	459,717.50	1		4,727	121
Liebes, S.	Genetics	Relationship of mass spectroscopy to organic materials.	*NSG8160	NASA	459,717.50	1		2,881	5,610
Reynolds, W.	Genetics	Automation in mass spectrometer instrumentation systems.	*NSG8160	NASA	459,717.50	1		99,044	11,675
Stryer, L.	Biochemistry	Electronic energy transfer; structure of macromolecules; protein structure and function.	*NGR05020	NASA	54,783.20	1		181	376
Tucker, R.	Genetics	Computer system to control mass spectrometer - GLC apparatus; data analysis.	*NSG8160	NASA	459,717.50	1		109,225	7,920
Wilson, D.	Biological Sciences	Analysis of neurophysiological data.	NB07631	NIH	61,364.44	1		768	982
Yguerabide, J.	Biochemistry	Electronic energy transfer; structure of macromolecules; protein structure and function.	*NGR05020	NASA	54,783.20	1		30	37
Zwick, M.	Biochemistry	Theoretical techniques for solving protein crystal structures.	*NGR05020	NASA	54,783.20	1		1	152
							SUB-TOTAL	1,495,412	77,390

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						2	Biomedical research service - routine terminals	at .1 cent per pageminute	at .10 cents per block
Atkinson, M.	Stanford Medical School - Admissions Committee	Assist Admissions Committee in selecting new Medical School classes.	None	University Funds	University Operating Account	2		6,677	368
Bagshaw, M.	Radiology	Radiation dosimetry.	None	American College of Radiology	$ 9,499.52	2		3	48
Bergstresser, P.	Dermatology	Computing blood flow in fingers and toes.	None	University Funds	University Operating Account	2		228	020
Brown, B.	Community & Preventive Medicine	Computations done in support of a multitude of public health research projects.	None	University Funds	University Operating Account	2		51,311	1,682
Brown, B.	Community & Preventive Medicine	Development of new biostatistical techniques.	None	University Funds	University Operating Account	2		23,099	302
Brown, B.	Community & Preventive Medicine	Conduct various statistical computations in support of research in the Department of Anesthesia.	GM12527	NIH	243,415.35	2		8,899	80
Crowley, L.	Surgery	Study of results of antibiotic agents instilled into wound at time of surgery to reduce infection rate of general surgery patients.	None	Bristol Laboratories	10,000.00	2		5,072	164
Durbridge, T.	Pathology	Compute research statistics.	None	University Funds	University Operating Account	2		363	83
Enlander, D.	Pathology	Statistical analysis of the data generated in the clinical lab.	None	University Funds	University Operating Account	2		47,070	174
Fletcher, G.	Anesthesia	Statistical analysis of laboratory results from in-vivo and in-vitro studies of uptake, metabolism, and elimination of sedative drugs.	*None	Hartford Foundation	154,715.98	2		2,676	2
Forrest, W.	Anesthesia	Develop quality and quantity control system for large masses of clinical data.	None	University Funds	University Operating Account	2		1,442,030	31,179
Forrest, W.	Anesthesia	Develop quality and quantity control system for large masses of clinical data.	None	University Funds	University Operating Account	2		958	26,724
Grindle, J.	Community & Preventive Medicine	Correlate data of newborn infants with respiratory distress syndrome treated with oxygen and mechanical ventilation.	None	Council for Tabacco Research	18,633.09	2		0	4
Hilf, F.	Psychiatry	Differentiating paranoid from non-paranoid patients.	MH10976	NIH	160,407.26	2		3,079	3,370
Hogness, D.	Biochemistry	Recognize chromosome fragments in Drosophila.	AM07535	NIH	59,605.94	2		1,412	3
Huberman, J.	Biochemistry	Reducing data from equilibrium dialysis.	*GM07581	NIH	218,562.12	2		13,001	509
Kohen-Raz, R.	Pediatrics	Diagnosis and treatment of statis balance impairment in educationally handicapped school children.	OEG0701263	U. S. Office of Education	65,044.00	2		42,352	1,727
Koran, L.	Psychiatry	Relationship of student test scores to other variables.	None	University Funds	University Operating Account	2		0	24

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						2	Biomedical research service - routine terminals	at .1 cent per pageminute	at .10 cents per block
Kountz, S.	University of California - San Francisco - Surgery	Select recipients for renal homotransplantation; measure hemodynamic changes in transplant patients.	AM11290	NIH	$199,088.00	2		231,172	2,588
Kraemer, H.	Psychiatry	Biostatistical analysis of various psychological data.	None	University Funds	University Operating Account	2		37,963	1,398
Lederberg, J.	Genetics	Generate chemical structures on Sanders 720 display unit.	*NSG8160	NASA	459,717.50	2		84	1,427
Levinthal, E.	Genetics	Photointerpretation and enhancement.	*NSG8160	NASA	459,717.50	2		0	60
Lieberman, M.	Psychiatry	Measurement of the efficacy of "small groups" in education.	None	University Funds	University Operating Account	2		0	8
Liebes, S.	Genetics	Design aspects of imagery system to be landed on surface of Mars in course of Viking 1973 Lander Mission.	*NSG8160	NASA	459,717.50	2		0	5
Liebes, S.	Genetics	Investigating means of data processing for interpretation of photographic data from the Mariner Mars 1971 Orbiter program.	*NSG8160	NASA	459,717.50	2		0	8
Lorenson, M.	Pharmacology	Molecular mechanisms that control sheep-heart enzyme and carbohydrate metabolism.	AI04214	NIH	27,318.16	2		12,597	162
Luzzatti, L.	Pediatrics	Study family with chromosomal mosaicism in three generations.	CRCS40	National Foundation	68,190.68	2		54,997	2,226
Maffly, R.	Medicine - Lipid Research	Relationship of metabolism to sodium transport.	67627	American Heart Association	15,680.99	2		15,035	268
Maffly, R.	Medicine - Lipid Research	Study disorders of serum sodium concentration and serum urea nitrogen concentration.	None	University Funds	University Operating Budget	2		47,476	774
Miller, F.	Community & Preventive Medicine	Strabismus statistical evaluation.	RR00241	NIH	207,106.00	2		300	36
Nall, M.	Dermatology	Etiology of chronic skin disease.	None	Psoriasis Research Foundation	3,154.46	2		70,442	9,297
Nall, M.	Dermatology	Effect of electron beam on mycosis fungoides.	None	Presbyterian Medical Center, San Francisco	100.00	2		0	785
Nye, W.	Medicine - Microbiology	Immunochemistry statistical calculations and bibliography compilations.	*AI08211	NIH	127,454.83	2		30,584	649
Petralli, J.	Medicine - Infectious Diseases	Improvement of antibiotic sensitivity data and guidance in therapy.	None	University Funds	University Operating Account	2		381,813	30,044
Reynolds, W.	Genetics	Text management to support engineering instrumentation.	*NSG8160	NASA	459,717.50	2		1,552	3,131

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						2	Biomedical research service - routine terminals	at .1 cent per pageminute	at .10 cents per block
Rosenberg, L.	Medicine - Microbiology	Levels of serum complement in mice of diverse pedigree.	*AI08211	NIH	$127,454.83	2		8,795	1,216
Schneiderman, L.	Medicine - Ambulatory	Clinical research data indexing.	None	University Funds	University Operating Account	2		177,070	11,250
Sforza, L.	Genetics	Simulation of population genetics studies.	GB7785	NSF	51,528.00	2		61,065	1,962
Smallwood, R.	Medical Facilities Planning	Design of Stanford Medical Care Facilities.	None	University Funds	University Operating Account	2		168,560	14,405
Smith, P.	Anesthesia	Mechanical ventilation influences in newborns having respiratory failure.	*None	Hartford Foundation	154,715.98	2		0	192
Solomon, G.	Psychiatry	Relationship of stress and environmental manipulation to immunity.	None	Research Foundation	4,893.54	2		0	228
Stuedeman, D.	Genetics	Capital equipment inventory.	*NSG8160	NASA	459,717.50	2		2,154	2,314
Weissman, I.	Pathology	Statistical analysis and data handling.	AI09072	NIH	12,792.03	2		21,428	358
Whitcher, C.	Anesthesia	Establishing anesthesia staff call schedule.	None	University Funds	University Operating Account	2		14,222	644
Zackheim, H.	Dermatology	Determination of serum copper and ceruloplasmin levels in psoriasis patients.	None	Hartford Foundation	86,585.73	2		3,501	172
							SUB-TOTAL	2,991,740	152,070
						3	Non-Stanford, medical	at .2 cents per pageminute	at .10 cents per block
Clemes, H.	Mental Research Institute			U. S. Medical Research and Development Command		3		32,708	2,265
Daughters, G.	Palo Alto Medical Research Foundation			Foundation Funds		3		19,008	615
Daughters, G.	Palo Alto Medical Research Foundation			Foundation Funds		3		28,964	1,622
Daughters, G.	Palo Alto Medical Research Foundation			Foundation Funds		3		18,740	812
Daughters, G.	Palo Alto Medical Research Foundation			Foundation Funds		3		4,806	181
Ingels, N.	Palo Alto Medical Research Foundation			Foundation Funds		3		52,828	1,563
Stewart, L.	Palo Alto Medical Research Foundation			Foundation Funds		3		0	24

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						3	Non-Stanford, medical	at .2 cents per pageminute	at .10 cents per block
Tickner, E.	Palo Alto Medical Research Foundation			Foundation Funds		3		521,027	2,518
Tickner, E.	Palo Alto Medical Research Foundation			Foundation Funds		3		8,236	80
							SUB-TOTAL	686,317	9,680
						4	Student education, Medical School	at .1 cent per pageminute (full credit)	at .10 cents per block (full credit)
Brast, N.	Medical Student	Storing and searching biographic information.	*RR00311	NIH		4		113	426
Brast, N.	Medical Student	Calculating descriptive and inferential statistics on experimental data.	*RR00311	NIH		4		42,888	1,859
Britt, R.	Medical Student	Auditory pathway responses to acoustic stimuli.	*RR00311	NIH		4		0	698
Brody, W.	Medical Student	Information processing in sensory systems.	*RR00311	NIH		4		918	2,173
Brody, W.	Medical Student	History taking and formulation of differential diagnoses.	*RR00311	NIH		4		32,911	306
Brown, B.	Medical Student	Serum levels of therapeutic agents and analyzing assay data.	*RR00311	NIH		4		45,237	4,544
Buchanan, B.	Medical Student	Determine whether medical students can learn statistical concepts by computer simulation.	*RR00311	NIH		4		45,702	1,321
Buchanan, B.	Medical Student	Determine whether medical students can learn statistical concepts by computer simulation.	*RR00311	NIH		4		6,818	13
Buchholz, W.	Medical Student	Investigation of time perspective, temporal relationships, and social function in para and quadraplegics.	*RR00311	NIH		4		0	29
Calvert, J.	Medical Student	Devising mathematical models to be used for public administration.	*RR00311	NIH		4		11,070	483
Edwards, D.	Medical Student	Effects of hormones on the alpha rhythm and temporal perception.	*RR00311	NIH		4		0	131
Enzmann, D.	Medical Student	Determination of secondary peristalsis of the esophagus.	*RR00311	NIH		4		108,120	12,875
Gamel, J.	Medical Student	Indicator dilution techniques for measuring pulmonary blood flow and lung transfer function.	*RR00311	NIH		4		97,928	3,833
Gelfand, M.	Medical Student	On-line analysis of cardiac catheterization data.	*RR00311	NIH		4		93,732	6,985
Gleason, C.	Medical Student	Self-education: how to use computers in electrophysiological research.	*RR00311	NIH		4		13,880	737
Hahn, P.	Medical Student	Interpretation, quantification, and systematic retrieval of information from gel electrophoreses.	*RR00311	NIH		4		18,578	406

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						4	Student education, Medical School	at .1 cent per pageminute (full credit)	at .10 cents per block (full credit)
Harris, R.	Medical Student	Correlation between human emotions and their appraisals of their environment.	*RR00311	NIH		4		5,776	204
Helikson, M.	Medical Student	Evaluating liver blood flow with radioactive isotopes.	*RR00311	NIH		4		105,576	10,178
Jan, W.	Medical Student	Statistical tests on data from laboratory experiments.	*RR00311	NIH		4		68,645	1,273
Levine, R.	Medical Student	Evaluate and process data obtained during biochemical assays.	*RR00311	NIH		4		7,174	320
Lipp, M.	Medical Student	Survey of medical students and graduate physicians regarding their experience with and opinions of marihuana.	*RR00311	NIH		4		12,680	26
Miller, S.	Medical Student	Analysis of data from an ANGER scintillation camera in connection with kidney blood flow studies.	*RR00311	NIH		4		52,512	5,502
Monnin, L.	Medical Student	Relationship of articulation and identification abilities of normal and speech defective children.	*RR00311	NIH		4		3,375	140
Nestor, L.	Medical Student	Establishment of computer-based program aimed at differential diagnosis.	*RR00311	NIH		4		8,333	181
Nola, G.	Medical Student	Perform statistical analysis of hemodynamic parameters.	*RR00311	NIH		4		0	14
Nowack, W.	Medical Student	Behavioral effects on catecholamine metabolism in the brain.	*RR00311	NIH		4		2,251	33
Peters, J.	Medical Student	Evaluation of residuals and outliers in parallel line assays.	*RR00311	NIH		4		44,914	323
Pope, S.	Medical Student	Statistical analysis of data sets of cardiovascular function parameters of various pharmaecologic agents.	*RR00311	NIH		4		2,568	185
Portlock, C.	Medical Student	Study of motivations for pregnancy.	*RR00311	NIH		4		0	8
Propper, R.	Medical Student	Study of inter-relationship of annogenesis glucomedgenesis in the perfused kidney.	*RR00311	NIH		4		2,637	139
Raybin, D.	Medical Student	Calculate results of assays and to handle other data calculations, statistics, etc.	*RR00311	NIH		4		1,210	3
Rosenfeld, R.	Medical Student	Studying the psychophysiological adaptation of male patients to the Coronary Care Unit.	*RR00311	NIH		4		0	9
Rosenthal, W.	Medical Student	Speech and language pathology; normal speech perception.	*RR00311	NIH		4		4,048	670
Sachs, D.	Medical Student	Study population growth rates in various nations and correlate these with natural resource use in order to understand medicine's role in alleviating problems posed by environmental deterioration.	*RR00311	NIH		4		7,523	938

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						4	Student education, Medical School	at .1 cent per pageminute (full credit)	at .10 cents per block (full credit)
Schwartz, B.	Medical Student	Statistical modeling of the growth, development, and ultimate senescence of cultured human fibroblasts.	*RR00311	NIH		4		487	19
Sethi, S.	Medical Student	Understand the replication of rhinoviruses.	*RR00311	NIH		4		6,892	63
Sinclair, A.	Medical Student	Measurement of intervals between beats of individual heart cells and administering drugs to cells to change environmental conditions, etc.	*RR00311	NIH		4		4,445	332
Smith, R.	Medical Student	Experimental study of family structure; socio-physiological studies of kidney transplant patients.	*RR00311	NIH		4		3,379	1,133
Swanson, G.	Medical Student	Interpret therapeutic drug action on respiratory control.	*RR00311	NIH		4		177,595	10,134
							SUB-TOTAL	1,040,215	68,546
						5	NIH grants not eligible to be charged - real time	at .01/2 cent per pageminute (full credit)	at .10 cents per block (full credit)
Bellville, J.	Anesthesia	Respiratory control mechanisms.	*GM12527	NIH	$243,415.35	5		97	158
Bellville, J.	Anesthesia	Pharmacology of anesthetics and related agents.	*GM12527	NIH	243,415.35	5		506,090	9,816
Bunnenberg, E.	Chemistry	Analysis of mass spectra and spectropolorimeter spectra; routine chemical analysis.	*GM12173	NIH	26,211.17	5		97,392	3,933
Bunnenberg, E.	Chemistry	Analysis of mass spectra and spectropolorimeter spectra; routine chemical analysis.	*GM12173	NIH	26,211.17	5		178,264	2,296
Bunnenberg, E.	Chemistry	Analysis of mass spectra and spectropolorimeter spectra; routine chemical analysis.	*GM12173	NIH	26,211.17	5		133,860	5,360
Bunnenberg, E.	Chemistry	Analysis of mass spectra and spectropolorimeter spectra; routine chemical analysis.	*GM12173	NIH	26,211.17	5		3,349	61
Duffield, A.	Chemistry	Analysis of mass spectra and spectropolorimeter spectra; routine chemical analysis.	*GM12173	NIH	26,211.17	5		377,988	2,519
Glick, D.	Pathology	Laser-microprobe element analysis.	HE06716	NIH	47,793.18	5		99,504	1,603
Roth, W.	Psychiatry	Habituation of evoked response and EEG desynchronization distinguishing arousal produced by emotional stimuli.	*MH11028	NIMH	90,936.37	5		82,604	2,924
Stillman, R.	Chemistry	Analysis of mass spectra and spectropolorimeter spectra; routine chemical analysis.	*AM04257	NIH	18,282.13	5		6,065	694
Trudell, J.	Chemistry	Interpreting mass spectroscopy.	*AM04257	NIH	18,282.13	5		319	78
							SUB-TOTAL	1,482,832	29,478

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						6	NIH grants not eligible to be charged - routine terminals	at .1 cent per pageminute (full credit)	at .10 cents per block (full credit)
Bernfield, M.	Pediatrics	Biochemistry in birth defects.	*HD02147	NIH	$257,700.07	6		29,059	655
Cann, H.	Pediatrics	Frequencies of genes controlling human heritable characters.	*GM15593	NIH	107,013.84	6		262,376	58,129
Cann, H.	Pediatrics	Frequencies of genes controlling human heritable characters.	GM15593	NIH	107,013.84	6		38,015	992
Champoux, J.	Biochemistry	Analytical ultracentrifuge experiments.	*AM07535	NIH	59,605.94	6		4,423	269
Chase, R.	Surgery	Evaluate facial growth in cleft palate children and to assess velopharyngeal competence.	DE02803	NIH	21,046.71	6		17,809	329
Clayton, R.	Psychiatry	Effects of steroids and hormones of RNA activity on the brain.	*HD00801	NIH	40,068.56	6		1,147	2,723
Cooper, J.	Psychiatry	Biochemical correlation of neonatal sexual differentiation in rats.	*HD00801	NIH	40,068.56	6		52,164	513
Doering, C.	Psychiatry	Investigating the causal connections, on a biochemical level, between hormones and behavior in stress.	*HD00801	NIH	40,068.56	6		11,585	2,561
Doherty, R.	Pediatrics	Random sampling of cells; statistical evaluations of data.	*HD02147	NIH	257,700.07	6		4,608	204
Efron, B.	Community & Preventive Medicine	Theoretical and applied research in biostatistics.	GM14554	NIH	30,268.39	6		8,896	569
Folk, W.	Biochemistry	Mitrants of Ecali, having altered activating enzymes.	GM13235	NIH	94,669.41	6		292	75
Fries, J.	Medicine - Immunology	Clinical information about rheumatic diseases.	AM05425	NIH	74,894.28	6		1,076	188
Hahn, G.	Radiology	Study of radiochemotherapy of mammalian cell cultures.	CA04542	NIH	20,647.49	6		45,865	682
Herzenberg, L.	Genetics	Collating multiple mouse immunoglobulin levels; store data and direct antiserum production.	*HD01287	NIH	53,728.13	6		32,027	9,193
Herzenberg, L.	Genetics	Collating multiple mouse immunoglobulin levels; store data and direct antiserum production.	*HD01287	NIH	53,728.13	6		5	12
Herzenberg, L.	Genetics	Collating multiple mouse immunoglobulin levels; store data and direct antiserum production.	*HD01287	NIH	53,728.13	6		8,287	624
Laipis, P.	Genetics	Statistical and mathematical reduction of data from experiments involving sucrose and cesium choloride gradients in the ultracentrifuge.	GM14108	NIH	43,240.25	6		0	157
Pearson, M.	Biochemistry	Compute normalized chromatographic elution profiles of viral SRNA.	*AM07535	NIH	59,605.04	6		0	10

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